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Whitcomb

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(54) **INTEGRATED HELMET HAVING BLUNT FORCE TRAUMA PROTECTION**

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This patent is subject to a terminal disclaimer.

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(52) **U.S. Cl.**
CPC ***A42B 3/121*** (2013.01); *A42B 3/128* (2013.01)

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CPC A42B 3/00; A42B 3/06; A42B 3/122; A42B 1/247; A42C 5/02; A61F 9/02; A41D 13/018
USPC ..... 2/411, 412, 413, 10, 171, 181.4, 908, 2/909, 918, 920, DIG. 10, DIG. 11, DIG. 3
See application file for complete search history.

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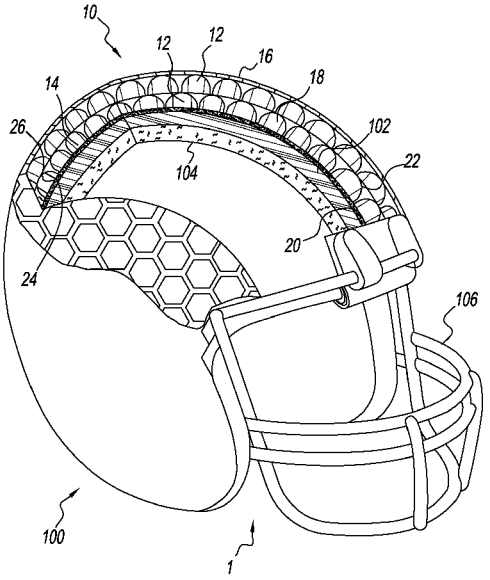
(57) **ABSTRACT**

An integrated helmet having blunt force trauma protection includes a helmet shell, an inner impact layer and the replaceable impact layer. The helmet shell is preferably fabricated from carbon fiber or a high impact plastic. A plurality of openings are formed through the helmet shell to reduce weight. The inner impact layer is attached to an inside surface of the helmet shell. The inner impact layer includes a plurality of deformable cells, which communicate with each other through a plurality of gas channels. The inner impact layer will not burst upon impact. The plurality of deformable cell chambers are filled with air to allow air to be displaced from one area to another area. The replaceable impact layer is attached to an outside surface of the helmet shell. The replaceable impact layer will burst upon impact.

20 Claims, 7 Drawing Sheets



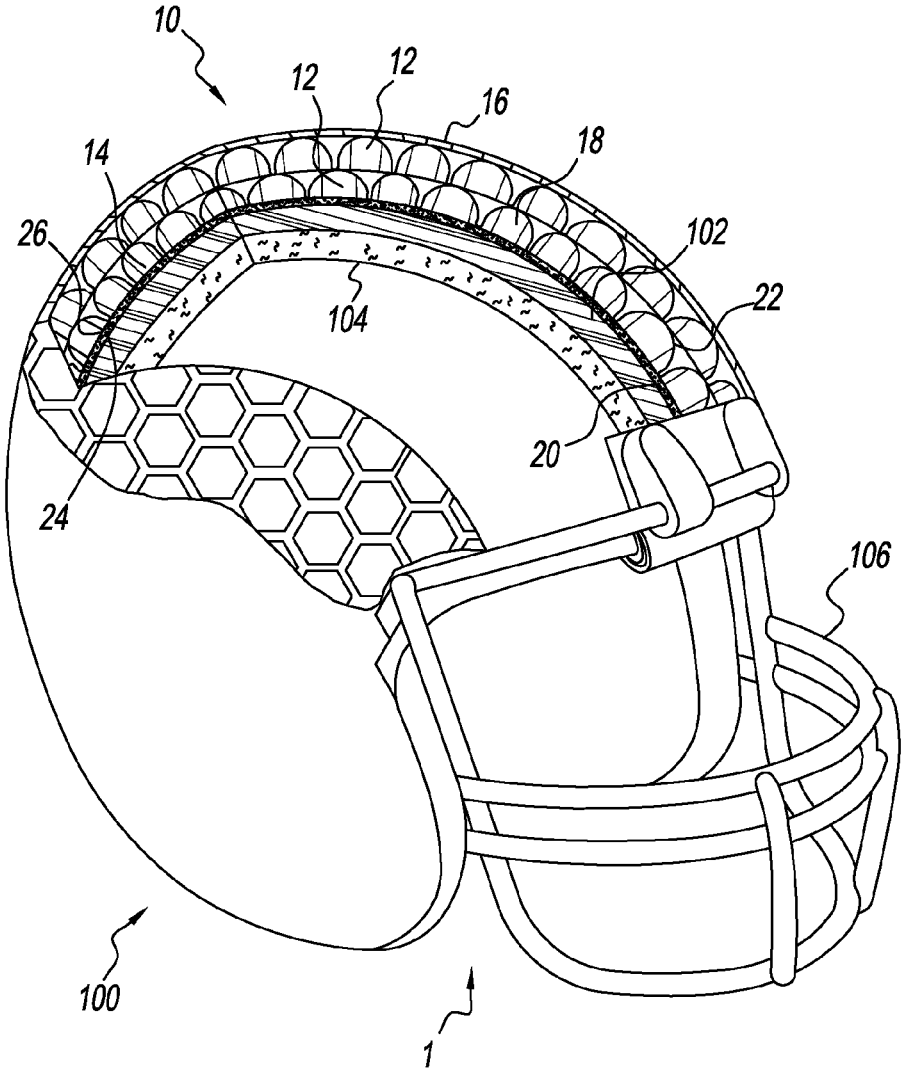


FIG. 1

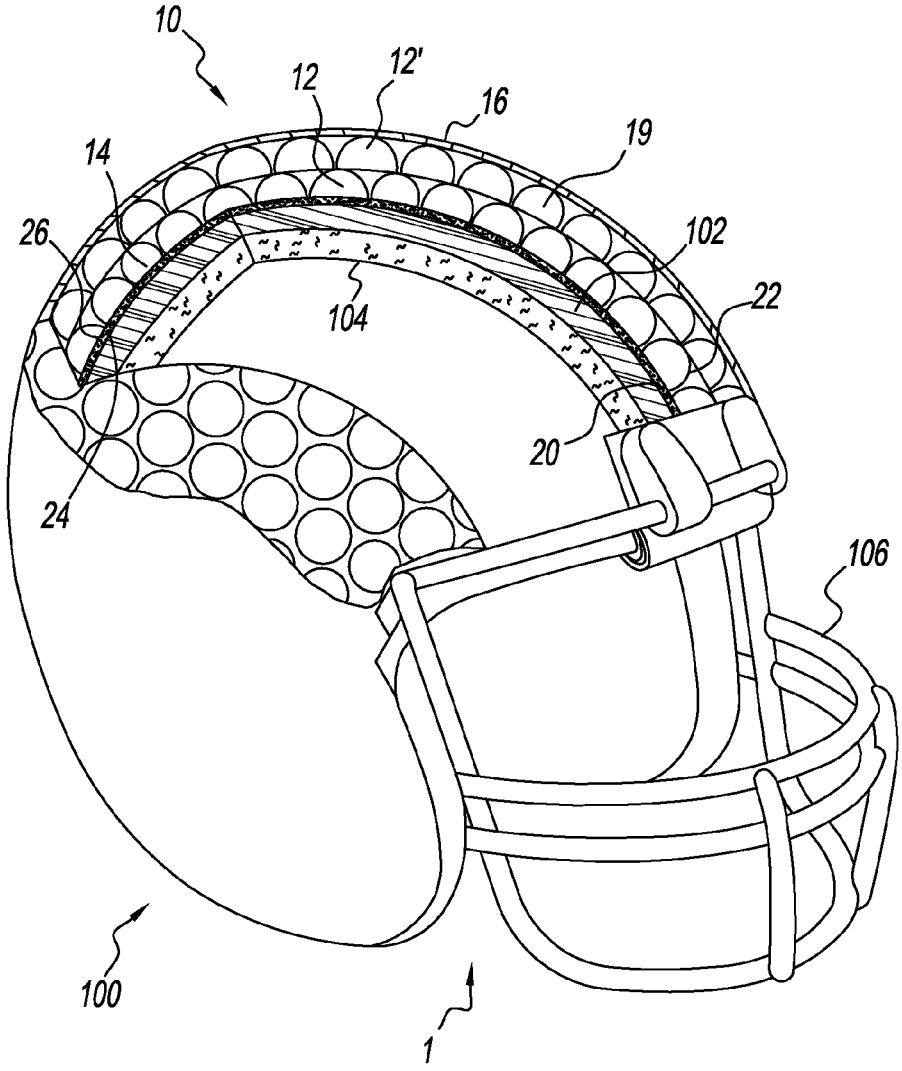


FIG. 1A

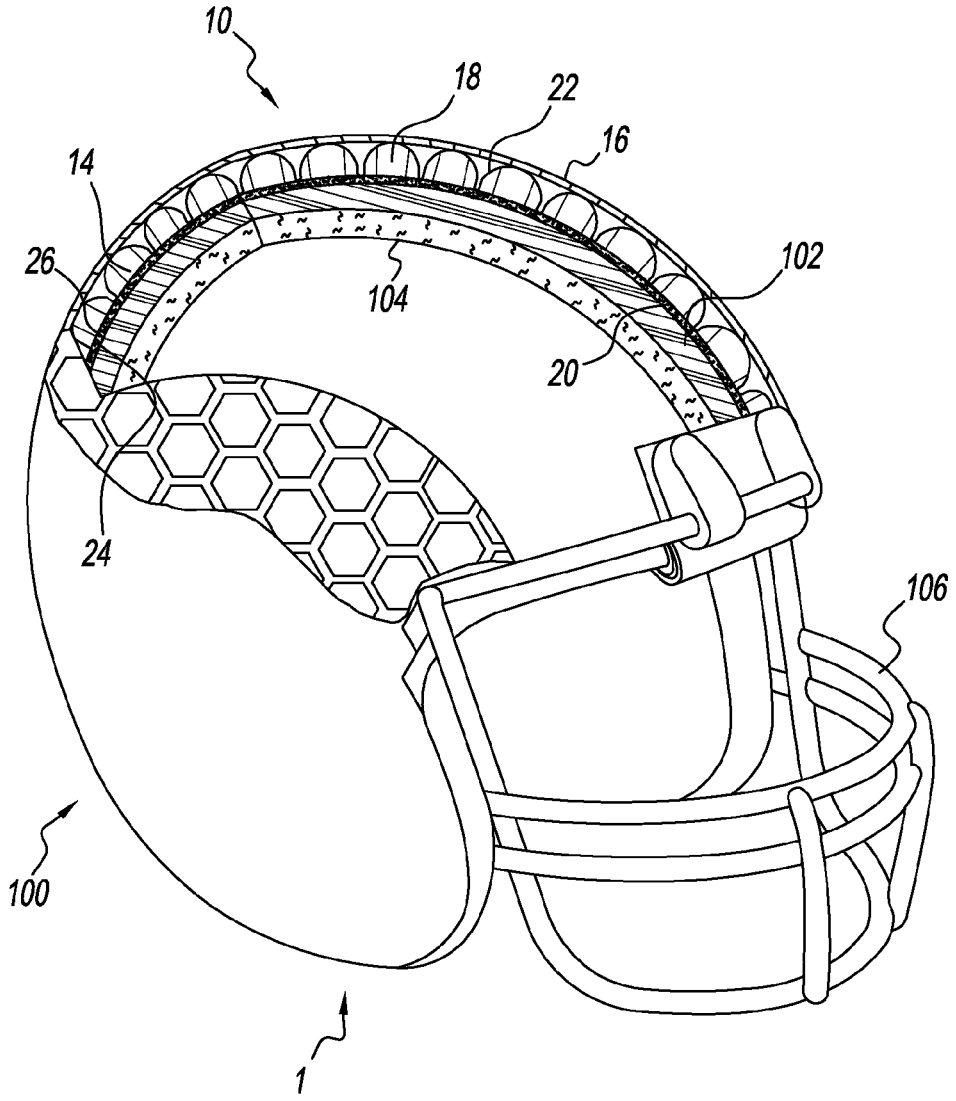


FIG. 2

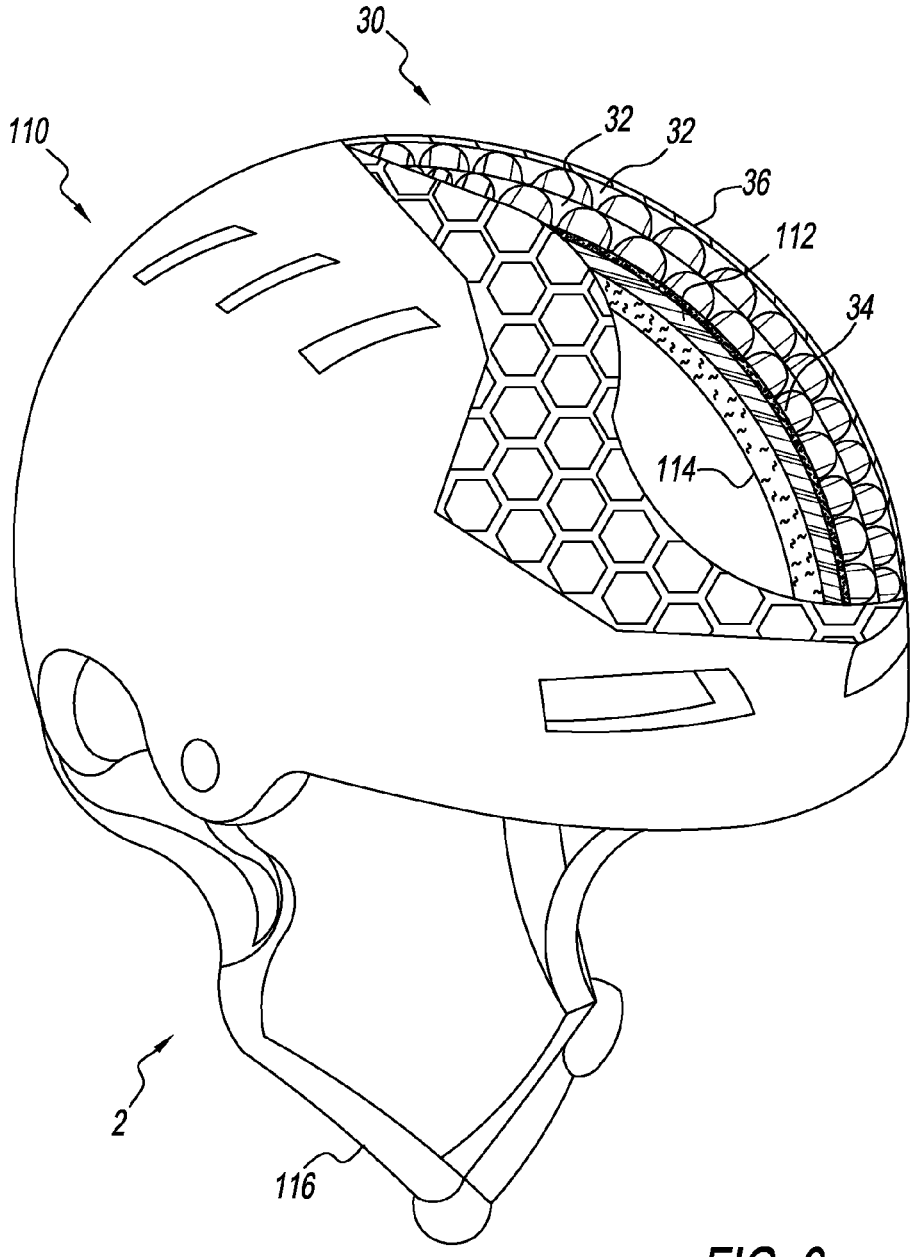


FIG. 3

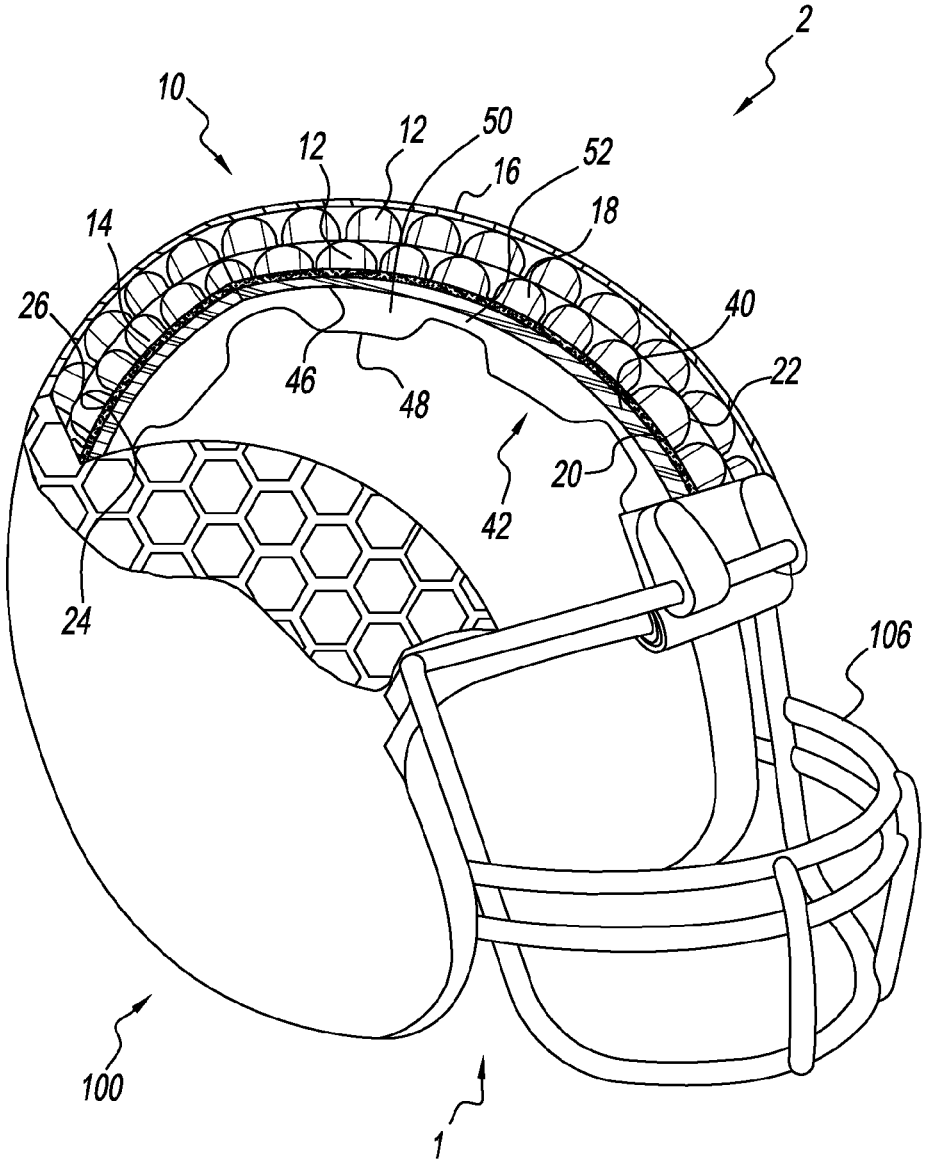


FIG. 4

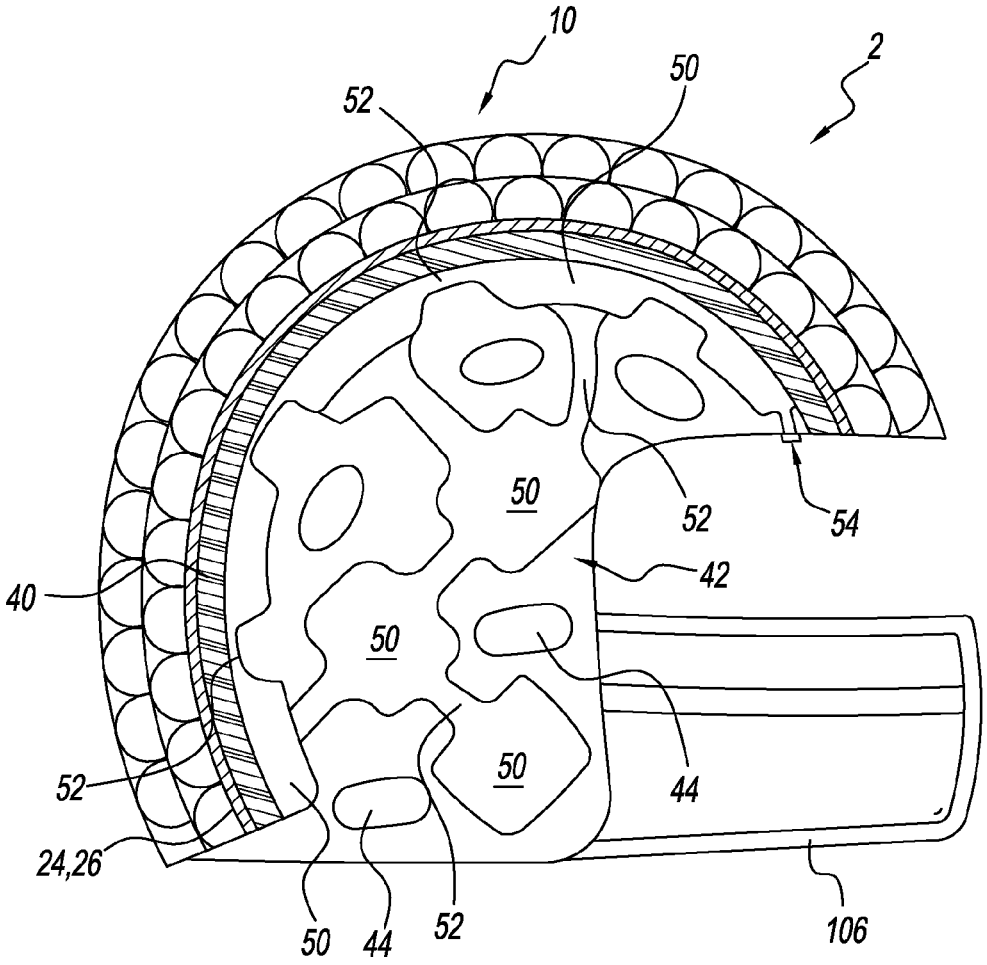


FIG. 5

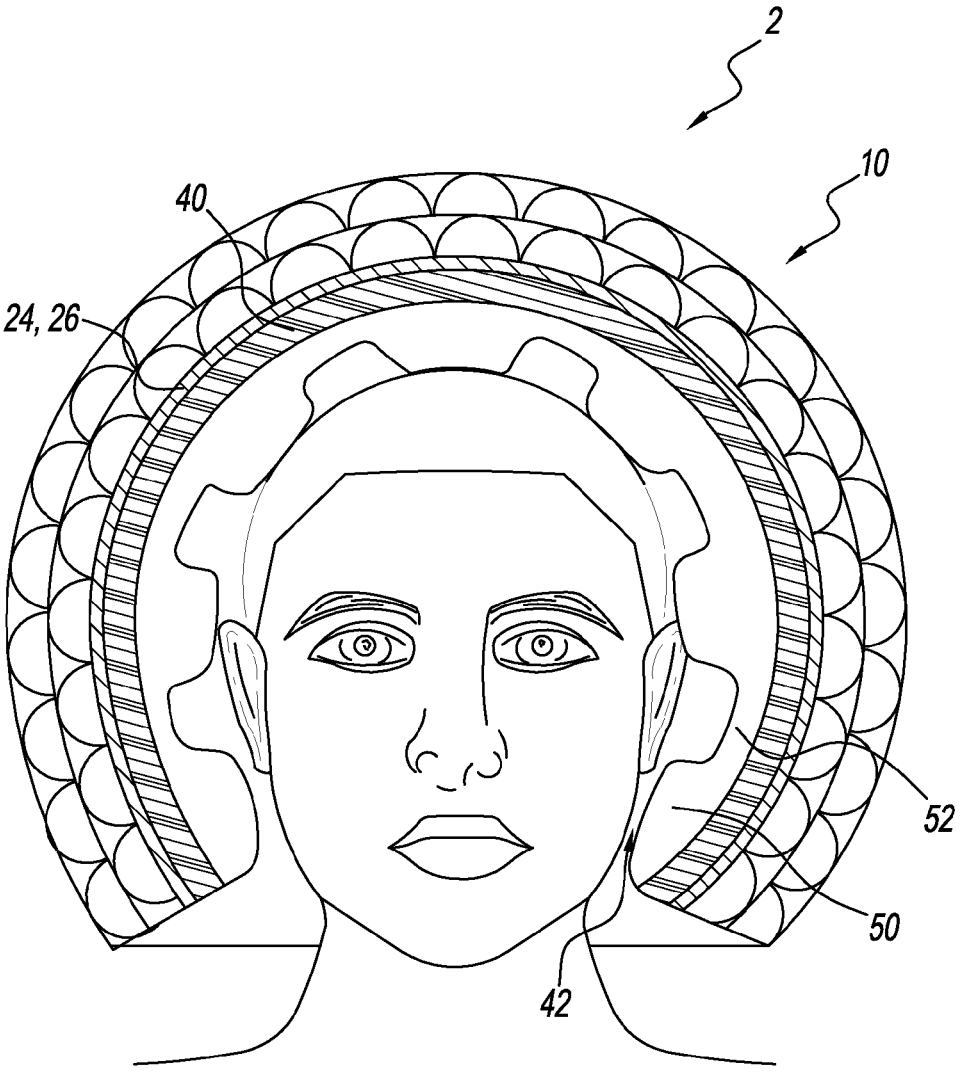


FIG. 6

INTEGRATED HELMET HAVING BLUNT FORCE TRAUMA PROTECTION

CROSS-REFERENCES TO RELATED APPLICATIONS

This is a non-provisional patent application, which claims the benefit of provisional application No. 61/967,291 filed On Mar. 10, 2014.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to helmets and more specifically to an integrated helmet having blunt force trauma protection, which includes a replaceable impact layer.

2. Discussion of the Prior Art

The purpose of protective helmets is to prevent head injury incurred during some event, such as football, ice hockey, horseback riding, skiing, lacrosse, baseball, cricket, sky diving (or any other sport using a helmet), riding a motorcycle, construction and military combat. Helmets were first invented for protection in military engagements, and as such, started as protection from hand held weapons and evolved in the 20th Century to protect from projectiles and explosives. As such, rigid, impenetrable helmets have been the paradigm we have used for the prevention of head injuries.

Rigid helmets have been partially successful at preventing injuries. However, the recent epidemic of concussions and the increasing awareness of the cumulative problems associated with repeated head trauma have unpacked the limitations of the current structure of protective helmets in all sports. Indeed, the same limitation could be claimed for all protective helmets including construction and military helmets.

The physics of head injury is all focused on the distance over which deceleration occurs. The human brain is very fragile, being composed of cells wrapped in membranes made of fluid fatty acids. Several trillion synapses in the brain are delicately poised in proximity to one another, without rigid and strong connections. These synapses are the functional means by which the brain operates. Shaking them disrupts them. The human nervous system has developed a host of strategies to enshrine the delicate neurons and their even more delicate synapse in a protective cocoon of safety. First and foremost, the brain is floating in water (otherwise called the cerebral spinal fluid), creating a bath without rigid inflexible supports. Within that water, the brain is suspended in a delicate spider web of suspending fibers and membranes that keep water from moving too quickly around the surface and allowing the soft brain to be gently suspended within the bony structure of the skull. The skull provides a rigid structure to contain the floating bath of fluid. Of note, the skull can be cracked and shattered as one strategy of dissipating force. This may lead to survival with subsequent healing. It is a unique and delicate bony structure around the brain, not seen anywhere else in the human body. The scalp provides an additional layer of safety. It is mobile and gives when struck, providing a few extra millimeters of deceleration distance. The scalp uniquely tears when stressed by direct blows, creating yet another mechanism of safety. The tearing creates large and dramatic scalp wounds in direct head trauma, but the brain underneath survives. Finally, the human skull is surrounded by hair, which can provide another layer of cushioning.

What are the physics of deceleration injury? The formula is simple: ΔVelocity/time=Deceleration. The change in velocity is divided by time. Rigid structures striking each other have a spike of deceleration within the first 0.00001 seconds. The more rigid and brittle, the higher the G-force generated for a shorter fragment of time. The Holy Grail of injury prevention in deceleration injury is to increase the distance and therefore time during which deceleration occurs. We are familiar with automobiles and have seen the effectiveness of airbags that increase the distance of deceleration of the human torso before it strikes the steering wheel. Vehicles are also designed to crumple so that force is taken up by bending metal, collapsing frames, shattering fenders, stretching seatbelts all of which increase the distance and time over which the human inside decelerates. Each of these strategies also complements the others to have a net effect of human survival, lowing the G forces from sufficient to break bones to simple sprains, strains and bruises.

Protective helmets have, to date, failed to provide a complete cocoon of safety. If the analogy to the human head can be used, protective helmets provide a skull and the inner dura, but there is no outer layer of safety. There is no scalp. No hair. Some advances have been made with the use of external foam with the SG Helmet. The missing ingredient in foam is that it fails to "fail". The human scalp tears and gives way. Foam doesn't tear. It does provide distance for greater deceleration, resulting in reduction of concussion injuries.

To continue the scalp analogy, helmets also lack the protection afforded the brain inside the skull; water in which to float the brain. All current sports helmets have some sort of light weight foam, some more rigid than others. The innovation claimed in this application is to add the internal effect of gas in large chambers that can provide give, gas movement and stretch, allowing for further distance of deceleration and thereby decreasing G forces transmitted to the brain.

It appears that the prior art does not teach or suggest the use of gas cells to create a more fluid means of slowing down deceleration and increasing the time/distance over which the deceleration occurs. The value of gas cells is that they easily deform, have little weight, stretch, deform rapidly with increasing resistance and, in extreme circumstances, burst. Bursting is a critical component, as it allows for the dissipation of force and then allows distance to increase as the next layer of cells can absorb the evolving contact. However, the essential stretching and increasing gas pressure upon contact makes for a gradient of deceleration, which will provide protection. Foam deforms but is not as fluid as gas cells, has greater weight, which may result in rotational injuries of the neck. The foam cannot burst thereby dissipating energy.

U.S. Pat. No. 3,872,511 to Nichols discloses protective headgear. U.S. Pat. No. 3,999,220 to Keltner discloses air cushioned protective gear. U.S. Pat. No. 4,586,200 to Poon discloses a protective crash helmet. U.S. Pat. No. 5,129,107 discloses an inflatable safety helmet specially for motorcycling.

Accordingly, there is a clearly felt need in the art for an integrated helmet having blunt force trauma protection, which includes an inner impact layer, a helmet shell and an external replaceable impact layer that covers the helmet shell and extinguishes instantaneous G-force deceleration shock waves applied thereto.

SUMMARY OF THE INVENTION

The present invention provides a helmet having blunt force trauma protection, which includes a replaceable impact layer. The helmet having blunt force trauma protection (blunt force helmet) includes a prior art helmet and a replaceable impact layer. The prior art helmet may be any type of helmet, such as a football helmet, an ice hockey helmet, a horseback riding

helmet, a roller derby helmet, a chainsaw, a logging helmet, a construction helmet, a military helmet, a pediatric medical helmet a motorcycle helmet, a bicycle helmet, a baseball helmet, lacrosse helmet or any type of protective helmet for a human head. The replaceable impact layer preferably includes at least one gas cell layer, a removable attachment system and an outer layer of sheet material. The at least one gas cell layer includes a plurality of gas cells created between two plastic sheets. The gas is preferably air, but could be any other suitable gas, such as substantially pure nitrogen or argon. Each cell will burst upon a pre-determined impact. Each cell will burst upon a pre-determined impact. The plurality of cells preferably have a hexagon shape, but other shapes may also be used, such as round or square. The removable attachment system is preferably hook and loop fasteners, but other suitable removable attachment systems may also be used. At least one first pad of hook and loop fasteners is attached to an exterior surface of a prior art helmet and at least one second pad of hook and loop fasteners is attached to a bottom surface of the replaceable impact layer.

An integrated helmet having blunt force trauma protection (integrated blunt force helmet) includes a helmet shell, an inner impact layer and the replaceable impact layer. The helmet shell is preferably fabricated from carbon fiber or a high impact plastic. A plurality of openings are formed through the helmet shell to reduce weight. The inner impact layer may be permanently or removably attached to an inside surface of the helmet shell. The inner impact layer includes a base sheet and an outside sheet. The outside sheet is attached to the base sheet to form a plurality of deformable cell chambers, which communicate with each other through a plurality of gas channels. The gas is preferably air, but could be any other suitable gas, such as substantially pure nitrogen or argon. Each cell will burst upon a pre-determined impact.

The base sheet and the outside sheet are strong enough to not burst upon impact. The plurality of deformable cell chambers formed between the base and outside sheets are partially filled with gas to allow the gas to be pushed from one area to another area. An instantaneous force of blunt trauma is dissipated by the plurality of deformable cell chambers stretching, and then by gas moving between the deformable cell chambers through the plurality of gas channels. The replaceable impact layer is attached to an outside surface of the helmet shell as described in the first embodiment.

Accordingly, it is an object of the present invention to provide a blunt force trauma helmet, which includes an external replaceable impact layer that covers a rigid helmet and extinguishes an instantaneous G-force deceleration shock wave applied to the rigid helmet.

It is a further objection of the present invention to provide an integrated blunt force trauma helmet, which includes a helmet shell, an inner impact layer and a replaceable impact layer.

Finally, it is another objection of the present invention to provide an integrated blunt force trauma helmet, which is light weight.

These and additional objects, advantages, features and benefits of the present invention will become apparent from the following specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective cut-away view of a blunt force football helmet with a replaceable impact layer having two gas cell layers in accordance with the present invention.

FIG. **1***a* is a perspective cut-away view of a blunt force football helmet with a replaceable impact layer having two gas cell layers with round gas cells in accordance with the present invention.

FIG. **2** is a perspective cut-away view of a blunt force football helmet with a replacement impact layer having a single a cell layer in accordance with the present invention.

FIG. **3** is a perspective cut-away view of a blunt force bicycle helmet with a replacement impact layer having two gas cell layers in accordance with the present invention.

FIG. **4** is a perspective cut-away view of an integrated blunt force football helmet with a replaceable impact layer having two gas cell layers in accordance with the present invention.

FIG. **5** is a lengthwise cross sectional view of an integrated blunt force football helmet with a replaceable impact layer having two gas cell layers in accordance with the present invention.

FIG. **6** is a widthwise cross sectional view of an integrated blunt force football helmet with a replaceable impact layer having two gas cell layers in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference now to the drawings, and particularly to FIG. **1**, there is shown a perspective cut-away view of a blunt force football helmet **1**. The blunt force helmet **1** includes a prior art helmet and a replaceable impact layer **10**. The prior art helmet may be any type of helmet, such as a football helmet **100**, a motorcycle helmet, a bicycle helmet, a baseball helmet, lacrosse helmet or any type of protective helmet for a human head. The football helmet **100** includes a hard exterior shell **102**, a padded interior **104** and a face mask **106**. With reference to FIG. **2**, the replaceable impact layer **10** preferably includes at least one gas cell layer **12**, a removable attachment system **14** and an outer layer of sheet material **16**. The at least one gas cell layer **10** includes a plurality of gas cells **18** created by a base sheet **20** and a cell sheet **22**. The gas is preferably air, but could be any other suitable gas, such as substantially pure nitrogen or argon. Each cell will burst upon a pre-determined impact.

Each of the gas cells **18** will burst upon a pre-determined impact. The following value is given by way of example and not way of limitation. It is preferably that the plurality of cells **18** burst in response to an impact of about 40 gs. The plurality of gas cells **18** preferably have a hexagon shape, but other shapes may also be used, such as round or square. FIG. **1***a* discloses two gas cell layers **12'** with a plurality of gas cells **19** having a round shape. The removable attachment system **14** is preferably hook and loop fasteners, but other suitable removable attachment systems may also be used. At least one first pad **24** of hook and loop fasteners is attached to an exterior surface of the shell **102** and at least one second pad **26** of hook and loop fasteners is attached to a bottom surface of the replaceable impact layer **10**. The outer layer of sheet material **16** is preferably attached to a top surface of the gas cell layer **12** with adhesive or any other suitable method.

With reference to FIG. **3**, a blunt force helmet **2** includes a bicycle helmet **110** and the replaceable impact layer **30**. The bicycle helmet **110** includes a hard exterior shell **112**, a padded interior **114** and a strap **116**. The replaceable impact layer **30** preferably includes two gas cell layers **32**, a removable attachment system **34** and an outer layer of sheet material **36**. The replaceable impact layer **30** has all the features of replaceable impact layer **10**. A top of a first gas cell layer **32** is attached to a bottom of a second gas cell layer **32** with

adhesive or any other suitable method. The removable attachment system **34** has all the features of the replaceable impact layer **14**.

The gas cells **18** on the blunt force helmets **1**, **2** will burst in the area of the impact, when a force of about 40 gravitational units (40 gs) is experienced by someone wearing the blunt force helmets **1**, **2**. A gravitational unit is equal to 9.801 m/s^2. Damaged replaceable impact layers **10**, **30** are removed from the blunt force helmets **1**, **2** and replaced with new replaceable impact layers **10**, **30**. The outer layer of sheet material **16**, **36** allows identification, such as team identification or advertising to be printed on an outside surface of the replacement layer **10**, **30**.

With reference to FIGS. **4-6**, an integrated blunt force helmet **2** includes a helmet shell **40**, an inner impact layer **42** and the replaceable impact layer **10**. The helmet shell **40** is preferably fabricated from carbon fiber or a high impact plastic. A plurality of openings **44** are preferably formed through the helmet shell **40** to reduce weight. The inner impact layer may be permanently attached to an inside surface of the helmet shell **40** with adhesive or the like, or removably attached to an inside surface of the helmet with VELCRO or any other suitable method. The inner impact layer **42** includes a base sheet **46** and an outside sheet **48**. The outside sheet **48** is attached to the base sheet **46** to form a plurality of deformable cells **50**, which communicate with each other through a plurality of gas channels **52**. The base sheet **46** and the outside sheet **48** are strong to not burst upon impact. The plurality of deformable cells **50** formed between the base and outside sheets are partially filled with a gas to allow the gas to be pushed from one area to another area. However, a fill nozzle **54** may be included to allow an end user to fill the inner impact layer **42** with the desired amount of gas through a gas pump or the like. The gas is preferably air, but could be any other suitable gas, such as substantially pure nitrogen or argon. Each cell will burst upon a pre-determined impact. The replaceable impact layer **10** is attached to an outside surface of the helmet shell **40** with hook and loop fastener pads **24**, **26**, but other suitable removable attachment systems may also be used.

While particular embodiments of the invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the invention in its broader aspects, and therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. An integrated helmet having blunt force trauma protection comprising:

a helmet shell having an inside surface and an outside surface;

an impact layer including a first sheet and a second sheet, said first sheet is attached to said second sheet to form a plurality of deformable cell chambers and a plurality of gas channels, wherein said plurality of gas channels are connected between said plurality of deformable cell chambers to allow gas flow between said plurality of cell chambers, said inner impact layer is attached to said inside surface of said helmet shell; and

a replaceable impact layer includes at least one cell layer, one of said at least one gas cell layer includes a base sheet and a cell sheet, a plurality of gas cell chambers are created by joining said cell sheet to said base sheet, some of said plurality of cell chambers will burst upon a pre-determined impact value, said replaceable impact layer is removably attached to said outside surface of said helmet shell.

2. The integrated helmet having blunt force trauma protection of claim **1**, further comprising:

an outer layer of sheet material is attached to said cell sheet.

3. The integrated helmet having blunt force trauma protection of claim **1** wherein:

said plurality of cells having a shape of at least one of hexagon, round and square.

4. The integrated helmet having blunt force trauma protection of claim **1** wherein:

a removable attachment system includes at least one first attachment pad and at least one second attachment.

5. The integrated helmet having blunt force trauma protection of claim **4** wherein:

said at least one first attachment pad and at least one second attachment pad include hook and loop fasteners.

6. The integrated helmet having blunt force trauma protection of claim **1** wherein:

said helmet is one of a football helmet, a motorcycle helmet, a bicycle helmet, a baseball helmet, a lacrosse helmet, an ice hockey helmet, a horseback riding helmet, a skiing helmet, a lacrosse helmet, a construction and military combat helmet.

7. The helmet having blunt force trauma protection of claim **1** wherein:

said gas being one of air, substantially pure nitrogen and argon.

8. An integrated helmet having blunt force trauma protection comprising:

a helmet shell having an inside surface and an outside surface;

an impact layer including a first sheet and a second sheet, said first sheet is attached to said second sheet to form a plurality of deformable cell chambers and a plurality of air channels, wherein said plurality of air channels are connected between said plurality of deformable cell chambers to allow air flow between said plurality of cell chambers, said impact layer is applied to said inside surface of said helmet shell;

a replaceable impact layer includes at least one cell layer, one of said at least one gas cell layer includes a base sheet and a cell sheet, a plurality of gas cells are created by joining said cell sheet to said base sheet, some of said plurality of cells will burst upon a predetermined impact value; and

a removable attachment system for removable attachment of said at least one gas cell layer to said outside surface of said helmet shell.

9. The integrated helmet having blunt force trauma protection of claim **8**, further comprising:

an outer layer of sheet material is attached to said cell sheet.

10. The integrated helmet having blunt force trauma protection of claim **8** wherein:

said plurality of cells having a shape of at least one of hexagon, round and square.

11. The integrated helmet having blunt force trauma protection of claim **8** wherein:

said removable attachment system includes at least one first attachment pad and at least one second attachment.

12. The integrated helmet having blunt force trauma protection of claim **11** wherein:

said at least one first attachment pad and at least one second attachment pad include hook and loop fasteners.

13. The integrated helmet having blunt force trauma protection of claim **8** wherein:

said helmet is one of a football helmet, a motorcycle helmet, a bicycle helmet, a baseball helmet, a lacrosse helmet, an ice hockey helmet, a horseback riding helmet, a skiing helmet, a lacrosse helmet, a construction and military combat helmet.

14. The helmet having blunt force trauma protection of claim **8** wherein:

said gas being one of air, substantially pure nitrogen and argon.

15. An integrated helmet having blunt force trauma protection comprising:

a helmet shell having an inside surface and an outside surface;

an inner impact layer including a first sheet and a second sheet, said first sheet is attached to said second sheet to form a plurality of deformable cell chambers and a plurality of air channels, wherein said plurality of air channels are connected between said plurality of deformable cell chambers to allow air flow between said plurality of deformable cells chambers, said inner impact layer is attached to said inside surface of said helmet shell; and

a replaceable impact layer includes at least one cell layer, one of said at least one gas cell layer includes a base sheet and a cell sheet, a plurality of gas cells are created by joining said cell sheet to said base sheet, some of said plurality of cells will burst upon an impact value of 40 gs, said replaceable impact layer is removably attached to said outside surface of said helmet shell.

16. The integrated helmet having blunt force trauma protection of claim **15**, further comprising:

an outer layer of sheet material is attached to said cell sheet.

17. The integrated helmet having blunt force trauma protection of claim **15** wherein:

said plurality of cells having a shape of at least one of hexagon, round and square.

18. The integrated helmet having blunt force trauma protection of claim **15** wherein:

a removable attachment system includes at least one first attachment pad and at least one second attachment pad.

19. The integrated helmet having blunt force trauma protection of claim **18** wherein:

said at least one first attachment pad and at least one second attachment pad include hook and loop fasteners.

20. The integrated helmet having blunt force trauma protection of claim **15** wherein:

said helmet is one of a football helmet, a motorcycle helmet, a bicycle helmet, a baseball helmet, a lacrosse helmet, an ice hockey helmet, a horseback riding helmet, a skiing helmet, a lacrosse helmet, a construction and military combat helmet.

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